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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/103,873	06/24/1998	YOSHIHISA NAGANO	YAO-3950	3577

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ANDREW L NEY
RATNER & PRESTIA
SUITE 301 ONE WESTLAKES BERWYN
P O BOX 980
VALLEY FORGE, PA 194820980

EXAMINER	
DIAZ, JOSE R	

ART UNIT	PAPER NUMBER
2815	

DATE MAILED: 03/02/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/103,873	NAGANO ET AL.	
	Examiner	Art Unit	
	José R Díaz	2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *07 November 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,4,6-27,29-31 and 33-38* is/are pending in the application.

4a) Of the above claim(s) *11-27* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,4,6-10,29-31 and 33-38* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, 8, 29, and 36-38 are rejected under 35 U.S.C. 102(b) as being anticipated by Patel et al. (US Pat. No. 5,374,578).

Regarding claims 1 and 8, Patel et al. teaches a semiconductor device, comprising: a capacitor provided on a supporting substrate (8) and including a lower electrode (12), a dielectric layer (14), and an upper electrode (16), said dielectric layer being formed from a ferroelectric material (FE) (see fig. 12); a first interlayer insulating layer (18) provided so as to cover the capacitor (see fig. 12); a first interconnect (26) selectively provided on the first interlayer insulating layer and electrically connected to the capacitor through a first contact hole formed in the first interlayer insulating layer (see fig. 12); a second interlayer insulating layer (28) consisting of an interlayer insulating film having a tensile stress provided on the first interconnect (see fig. 12); and a second interconnect (29) selectively provided on the second interlayer insulating layer and electrically connected to the first interconnect through a second contact hole formed in the second interlayer insulating layer (see fig. 12). With regards to the tensile stress, Patel et al. teaches that the dielectric layer 28 comprises APCVD TEOS-O_3 (see col. 6, lines 5-7), which is further heated at a temperature of less than 450 °C (see col. 6, lines

18-21). It is very well known in the art that APCVD TEOS-O_3 oxide film inherently has a tensile stress in the order of 10^9 dyne/cm^2 when deposited and maintains a value within this order after the heating step, since this is a physical characteristic of such a film[1,2].

Regarding claim 29, Patel et al. teaches that the second interlayer insulating layer (28) provides substantially flat step coverage of the first interconnect (26) and the first interlayer insulating layer (18) (see fig. 12).

Regarding claim 36, Figure 12 of Patel et al. shows a singular second interlayer insulating film (28).

Regarding claim 37, Patel et al. teaches that the second interlayer insulating layer 28 is formed by a thermal ozone TEOS (APCVD TEOS-O_3) (see col. 6, lines 5-7).

Regarding claim 38, Patel et al. teaches that the supporting substrate includes an integrated circuit thereon (consider the circuit defined by source (S) and drain (D) regions in fig. 12).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

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[1] Fundamentals of Chemical of Chemical Vapor Deposition. TEOS / OZONE Thermal CVD. Film Quality: Moisture, Stress, Cracking. Tutorial [online]. TimeDomain CVD Inc., 2002 [retrieved on 2004-02-18]. Retrieved from the Internet: < URL: http://www.timedomaincvd.com/CVD_Fundamentals/films/TEOS_O3_thermal.html > (Please refer to Stress vs. Temperature graph for a typical APCVD TEOS/O_3 SiO_2).

[2] Wolf et al.,"Silicon Processing for the VLSI Era Volume 1: Process Technology", Lattice Press, 1986, pp. 183. (Please refer to Table 2: APCVD vs. Stress).

> invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 4 and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Patel et al. (US Pat. No. 5,374,578) in view of Zafar (US Pat. No. 5,750,419).

Regarding claims 4 and 35, Patel et al. teaches that the second interconnect (29) is provided on the second interlayer insulating film (28) so as to cover at least a part of the capacitor (12, 14, 16) (see fig. 12). However, Patel et al. fails to teach the claimed limitation of a passivation layer provided so as to cover the second interconnect. Zafar teaches that it is well known in the art to include the further limitation of a passivation layer (52) (see fig. 5) provided so as to cover the second interconnect (see col. 2, line 67 and col. 3, lines 1-2), wherein the passivation layer is formed from a laminate including a silicon oxide film and a silicon nitride film (see col. 2, lines 63-65).

Patel et al. and Zafar are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to include a passivation layer formed from

a laminate including a silicon oxide film and a silicon nitride film. The motivation for doing so, as is taught by Zafar, is to reduce stress on the ferroelectric capacitor (col. 3, lines 66-67 and col. 4, line 1). Therefore, it would have been obvious to combine Zafar with Patel et al. to obtain the invention of claims 4 and 35.

Claims 6 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Patel et al. (US Pat. No. 5,374,578) in view of Hanagasaki (US Pat. No. 5,767,541).

Regarding claim 6 and 10, Patel et al. fails to teach claimed materials for the first and second interconnect layers. Hanagasaki teaches that it is well known in the art to form the first interconnect layer (14) from a laminate including titanium, titanium nitride and aluminum (col. 8, lines 50-56); and the second interconnect layer (5) from a laminate including titanium and aluminum (col. 10, lines 35-38).

Patel et al. and Hanagasaki are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to include a first interconnect layer comprising a laminate including titanium, titanium nitride and aluminum; and a second interconnect layer comprising a laminate including titanium and aluminum. The motivation for doing so, as is taught by Hanagasaki, is to obtain good ohmic contact (col. 8, lines 48-49). Therefore, it would have been obvious to combine Hanagasaki with Patel et al. to obtain the invention of claims 6 and 10.

Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Patel et al. (US Pat. No. 5,374,578) in view of Applicant's admitted prior art.

Regarding claim 9, Patel et al. is silent with respect to the thickness of the second interlayer insulating film. Applicant acknowledges that it is well known in the art to form the second interlayer insulating film (15) having a thickness of about 1 μm (see page 4, line 22). With regards to the thickness range of 0.3-1μm, it would have been obvious to one of ordinary skill in the art, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or working ranges involves only routine skill in the art. In re Aller, 105 USPQ 233.

Patel et al. and Applicant's admitted prior art are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to include a second interlayer insulating film of about 1 μm thick. The motivation for doing so, as is taught by Applicant, is to isolate the first interconnect (page 3, lines 22-23). Therefore, it would have been obvious to combine Applicant's admitted prior art with Patel et al. to obtain the invention of claim 9.

Claims 8, 30 and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Patel et al. (US Pat. No. 5,374,578) in view of Matsuki et al. (US Pat. No. 5,960,252).

Regarding claims 8, 30 and 31, Patel et al., as stated supra, teaches the claimed structure (see rejection for claims 1 and 8). However, Patel et al. is silent with respect to

the remnant polarization characteristic of the ferroelectric film and the Si-OH bond absorption coefficient of the second interlayer insulating layer. Matsuki et al. teaches that it is well known in the art to include a protective stack of insulating layers comprising a sputtered silicon oxide layer (20) and a CVD ozone-TEOS layer (21) (see fig. 4) to suppress degradation of the ferroelectric film in the polarization property thereof (see col. 6, lines 14-17). Furthermore, Matsuki et al. teaches a remnant polarization of more than 10 $\mu C/cm^2$ (see figures 3A-3C). With regards to the remnant polarization value of about 10 $\mu C/cm^2$ and the Si-OH bond absorption coefficient of 800 cm^{-1} or less corresponding to a wavelength of 3450 cm^{-1}, it would have been obvious to one of ordinary skill in the art, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Patel et al. and Matsuki et al. are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to include a remnant polarization of at least 10 $\mu C/cm^2$ and a Si-OH bond absorption coefficient of 800 cm^{-1} or less corresponding to a wavelength of 3450 cm^{-1}. The motivation for doing so, as is taught by Matsuki et al., is to suppress degradation of the ferroelectric film (col. 6, lines 13-20). Therefore, it would have been obvious to combine Matsuki et al. with Patel et al. to obtain the invention of claims 8, 30 and 31.

Claims 33 and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Patel et al. (US Pat. No. 5,374,578) in view of Arita et al. (US Pat. No. 5,624,864).

Regarding claims 33 and 34, Patel et al., as stated supra, teaches the claimed structure (see rejection for claims 1 and 8). However, Patel et al. fails to teach the limitation of further providing a passivation layer and a hydrogen-supplying layer. Arita et al. teaches that it is well known in the art to include hydrogen supplying layer (51) and passivation layer (50) (see fig. 17).

Patel et al. and Arita et al. are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to include hydrogen supplying layer and a passivation layer. The motivation for doing so, as is taught by Arita et al., is to suppress diffusion of moisture into the capacitor dielectric layer (col. 2, lines 54-58). Therefore, it would have been obvious to combine Arita et al. with Patel et al. to obtain the invention of claims 33 and 34.

Response to Arguments

Applicant's arguments, see remarks, filed November 7, 2003, with respect to the rejections of claims 1, 4, 6-10, 29-31 under 35 U.S.C. 103(a) have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of Patel et al.

In addition the indicated allowable subject matter has been withdrawn in view of the reference Patel et al. Any inconvenience to applicant is sincerely regretted.

Correspondence

Any inquiry concerning this communication or earlier communications from the examiner should be directed to José R Díaz whose telephone number is (571) 272-1727. The examiner can normally be reached on 9:00-5:00 Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on (571) 272-1664. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

JRD
2/19/04

Tom Thomas
Supervisory Patent Examiner
Art Unit 2800